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Biofuels – challenges and opportunities

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Short on biofuels

- Fuels produced from biological material
  - Bio-ethanol from plants rich in sugar and starches (sugarbeet, sugarcane, corn, wheat and other grains)
  - Biodiesel from oily plant material (palm oil, soy beans, jatropha, rapeseed, etc.) and animal fat
  - Second-generation fuels from lignocellulose (all plant material)
- Additive to and substitution for conventional petrol and diesel
  - Low-fraction blends used by conventional vehicles
  - High-fraction blends used by flexible fuel-vehicles

Why focus on biofuels? - current status in production and use

- **2005: Still only 1 % global market share of transport fuels but recent massive growth rates**
  - **2002-2005: Tripling of biofuel consumption (from 15 to 39 bill litres bioethanol and 3 billion litres biodiesel)**
  - **Brazil (20-30% market share of transport fuels)**
  - **Germany (6% of market share of transport fuels)**
- **2005: production still highly concentrated**
  - **USA and Brazil major producers (49% and 41% of global production**
  - **EU third largest producer (4%), but with 73% of total global biodiesel-production**
  - **Currently a range of feedstock producer countries acting on the new demand situation**

Policy driven demand

- **Government-set goals and programmes driven by energy supply security and climate change concerns and national agricultural/industrial interests**
  - **EU: 2003 Biofuel Directive (5,75% market share by 2010), in 2007 extended to 10% by 2020**
  - **USA: Energy Policy Act 2005 (goal to use 28 billion litres in 2012)**
  - **Brasil (5% biodiesel by 2013, in addition to bio-ethanol)**
  - **China (2.5% bioetanol 2005, 10% for some regions)**
  - **India (10% blending in 9 out of 28 states and 4 out of 7 territories)**
  - **Japan (20% market share by 2030)**
  - **Thailand (10% blending by 2007, 10% market share by 2012)**
  - **Malaysia (5% biodiesel share by 2008)**
  - **Etc.**

Scenarios for share of biofuels

- **Estimates of global technical and economic potentials for biofuels**
  - **Current estimates vary between 4% and 30% global market share for biofuels in 2050, depending on pace in commercialisation of cellulose-based fuels**
    - **IEA World Energy Outlook 2006 Reference scenario (4%)**
    - **IEA World Energy Outlook 2006 Alternative Scenario (7 %)**
    - **The IEA's 2006 Energy Technology Perspectives (13%)**
    - **OECD 2007 Roundtable study – 23% by 2050 (11% conventional fuels (20 EJ) and 12% second generation fuels (23 EJ)**
    - **BP (building on other IEA material) – 30% by 2050, potentially already in 2030**

What are the challenges and opportunities?

- Potential problems
  - Could biofuels aggravate the climate change problem?
  - Biofuels could create other environmental problems, notably loss of habitat and biodiversity
  - Biofuels could have negative social impacts
- Opportunities
  - Economic benefits to people living and working in the world's agriculture regions
  - Employment - more labour intensive than the fossil fuel industry

Biofuels and climate change

- 'Well to wheel **energy balances relative to conventional fuels** (i.e. energy content of fuel compared to energy needed to produce the fuel)
  - a climate problem when fossil fuels are used in cultivation, harvesting, transportation and refining
- Energy balances vary **between** biofuels due to variation in **acreage** needed for cultivation of feedstock – area-demanding crops need more energy for cultivation and harvesting
    - European wheat: 2500 litres of ethanol/hectare
    - Brazilian sugarcane: 6800 litres ethanol/hectare
    - European beat: 5300 litres ethanol/hectare
    - Indian sugarcane: 5200 litres/hectare
    - US test plots of switchgrasses: 13,900 litres/ethanol per hectare
    - European rapeseed: 1200 litres of biodiesel per hectare
    - Soy beans higher acreage needed per unit biodiesel
    - Palm oil lower acreage needed per unit biodiesel
- Energy balance variation between biofuels due to variation in N fertilisers put into cultivation of feedstock
  - N fertilisers are energy intensive in production and degrades into N_2O when used

Biofuels and climate change

- Energy balance variation across **areas** due to variation in soil fertility and local climate
  - Current tropical plants more favourable sunlight and water conditions, manual cultivation and fewer inputs of fertilizers and pesticides

- Biofuel feedstock cultivation replacing major **carbon stores** (rapid oxidation of carbon stores)
  - Overground stores (burning of forests)
  - Underground stores (oxidation of carbon stored in the soil when cultivating grass- and peatland)
  - Less problematic with biofuels cultivated on degraded and arid land (less carbon in soil)
  - Less problematic with second generation fuels based on perennial plants with root systems that sequester carbon

Other environmental problems

- Cultivation of feedstock for biofuels can **destroy habitat** and contribute to reducing **biological diversity**
  - De-forestration (alarm for palm oil production in Indonesia and Malaysia)
  - Habitat stress and loss of biodiversity from spreading of monocultures, use of water resources and pesticides, compaction and erosion of soil,
  - Invasive species (often high-growth plants that need no input of fertilizers, such as miscanthus)
  - Second-generation fuels: indication that some diverse systems will give higher yields than monocultures – opportunities for habitat restoration

Potential social problems

- Competition for land use
  - Increase in prices for food, feed and industrial fibres
  - Some areas, people and industries may gain – others will loose without compensating measures
- Working conditions at plantations
  - General agricultural industry problem – substandard wages and poor working conditions
- Local community conditions
  - Lack of trickle down effects
  - Increasing concentration of lands in the ownership of a few large landowners in developing countries
  - Takeover of land for biofuel cultivation by large international agribusinesses, wiping out traditional ways of living and sending people into poverty
  - Bonanza conditions similar to oil industry experiences

The challenges

- The huge challenges are to develop a global biofuel regulatory system enabling people to act on opportunities while avoiding the environmental and social problems

Acting on the challenge

- Current efforts to promote sustainable biofuels production and processing standards/certification schemes
  - WWF-initiated work together with industry and other stakeholders
    - Roundtables on Sustainable Palm Oil, Responsible Soy and Sustainable Biofuels, Better Sugarcane Inititative Biofuels
  - Work initiated by EU and EU member countries
    - The Netherlands
    - The UK
    - Germany
  - Initiatives to support and co-ordinate work for a global standard
    - FAO, IEA, UNEP, GEF

Acting on the challenges – EU and member countries

- EU will present proposals for standards in its second renewable energy directive in January 2008
  - Hearing processes launched on opportunities for mandatory standards/certification for member countries
  - Criteria on minimum well-to-wheel savings in climate gas emissions
  - Criteria on land use to avoid cultivation of feedstock on major carbon storage sites
  - Criteria to avoid land use changes with major negative impacts on biodiversity

UK and the Netherlands as frontrunners

- Co-operation on development of LCA methods for calculating climate gas emissions and standard development work
- Both countries opt for mandatory standards in the longer-term
- Only mandatory well-to-wheel **reporting** from biofuel marketing companies in the short-term due to uncertainties concerning compatibility with WTO rules
- Both countries have included environmental and social criteria in their standardisation programmes (broader in scope that common EU standard?)

Dutch draft standard scheme

- In order to count against Dutch goals and eligible support schemes, biofuels marketed should:
  - Contribute to net reductions of climate gas emissions (30% with a goal to achieve 80-90% reductions in ten years)rivstoff med mål å etterstrebe 80-90% reduksjon innen ti år)
  - Feedstock production should not conflict with conservation of important carbon stores
  - Must not prevent food supply and local biomass-based energy supply, supply to medical uses and construction materials
  - Must not interfer with protected or vulnerable biodiversity and if possible, increase biodiversity
  - Maintain or improve soil quality (concerning pesticides, erosion, nutrients)
  - Maintain or improve air quality (burning of forest normally not accepted)
  - Should lead to increased welfare among employees and local communities

The British draft standard

- **Environmental principles**
  - 1. Biomass production will not destroy or damage large above or below ground carbon stocks
  - 2. Biomass production will not lead to the destruction or damage to high biodiversity areas including avoiding deforestation
  - 3. Biomass production does not lead to soil degradation
  - 4. Biomass production does not lead to the contamination or depletion of water sources
  - 5. Biomass production does not lead to air pollution
- **Social principles**
  - 6. Biomass production does not adversely effect workers rights and working relationships
  - 7. Biomass production does not adversely affect existing land rights and community relations (ensure that biofuel supply doesn't affect food security and supply or reduce economic opportunities for workers in supply countries.

Conclusions – challenges ahead

- Making standards/certification truly international and binding on companies marketing fuels
- Standards must be complemented by national/international monitoring of land-use and impacts on food supply
- Financial and advisory support needed for implementation of sustainability standards in developing countries
- Financial support to conservation programmes of carbon stores/areas rich in biological diversity
- Overcoming barriers to commercialisation of technologies utilising cellulose-based material
- And many other challenges to ensure that biofuels becomes a blessing and not a curse